SECTION 15400
PLUMBING SYSTEMS

PART 1 - GENERAL

1.1 DESCRIPTION

Domestic water, sewer systems, including piping, equipment and all necessary accessories as designated in this section.

1.2 RELATED WORK

A. Penetrations in rated enclosures: Section 07270, FIRESTOPPING.

B. Preparation and finish painting and identification of piping systems: Section 09900, PAINTING.

C. Section 15050, BASIC METHODS AND REQUIREMENTS (MECHANICAL).

D. Pipe Insulation: Section 15250, INSULATION.

1.3 SUBMITTALS

A. Submit in accordance with Section 01340, SAMPLES AND SHOP DRAWINGS.

B. Manufacturer's Literature and Data:

1. Piping
2. Valves.
3. Strainers.
4. Pressure Gages.
5. Cleanouts.
6. All items listed in Part 2 - Products.

C. Detailed shop drawing of clamping device and extensions when required in connection with the waterproofing membrane or the floor drain.

1.4 APPLICABLE PUBLICATIONS

A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only.

B. Federal Specifications (Fed. Spec.):

L-C-53OC Coating, Pipe, Thermoplastic Resin

L-T-1512A Tape, Pressure Sensitive Adhesive, Pipe Wrapping

0-C-114B(2)Calcium Hypochlorite, Technical

0-S-602E Sodium Hypochlorite Solution

BB-C-120C Chlorine, Technical, Liquid

WW-U-516B Unions, Brass or Bronze Threaded, Pipe Connections and Solder-Joint Tube Connections

WW-V-35C Valve Ball Brass or Bronze

WW-V-1967 INT AMD 1 Valve, Butterfly (Threaded Ends And Solder Ends)

C. American National Standards Institute (ANSI):

American Society of Mechanical Engineers (ASME): (Copyrighted Society)

A13.1-81 Scheme for Identification of Piping Systems

B16.3-92 Malleable Iron Threaded Fittings ANSI/ASME

B16.4-92 Cast Iron Threaded Fittings Classes 125 and 250 ANSI/ASME

B16.9-93 Factory-Made Wrought Steel Buttwelding Fittings ANSI/ASME

B16.11-91 Forged Steel Fittings, Socket-Welding and Threaded ANSI/ASME

B16.12-83 Cast Iron Threaded Drainage Fittings ANSI/ASME

B16.15-85 Cast Bronze Threaded Fittings ANSI/ASME

B16.18-84 Cast Copper Alloy Solder-Joint Pressure Fittings ANSI/ASME

B16.22-89 Wrought Copper and Copper Alloy Solder Joint Pressure Fittings ANSI/ASME

B31.8-94 Gas Transmission and Distribution Piping Systems ANSI/ASME

B40.1-91 Gauges-Pressure Indicating Dial Type-Elastic Element ANSI/ASME

D. American Society for Testing and Materials (ASTM):

A47-90 Ferritic Malleable Iron Castings Revision 1989

A53-95 Pipe, Steel, Black And Hot-Dipped, Zinc-coated Welded and Seamless

A74-94 Cast Iron Soil Pipe and Fittings

A183-83(R1990 Carbon Steel Track Bolts and Nuts

A312-94 Seamless and Welded Austenitic Stainless Steel Pipe

A536-84(R1993 Ductile Iron Castings

A733-93 Welded and Seamless Carbon Steel and Austenitic Stainless Steel Pipe Nipples

B32-95 Solder Metal

B61-93 Steam or Bronze Castings

B62-93 Composition Bronze or Ounce Metal Castings

B75-93(Rev A)Seamless Copper Tube

B88-95 Seamless Copper Water Tube

B306-95 Copper Drainage Tube (DWV)

B584-93 Copper Alloy Sand Castings for General Applications Revision A

B687-88 Brass, Copper, and Chromium-Plated Pipe Nipples

C564-95 Rubber Gaskets for Cast Iron Soil Pipe and Fittings

E. American Water Works Association (AWWA):

C110-93 Ductile Iron and Gray Iron Fittings - 75 mm thru 1200 mm(3 inch thru 48 inches) for Water and other liquids

C151-91 Ductile-Iron Pipe, Centrifugally Cast in Metal Molds or Sand Lined Molds, for Water or Other Liquids

C203-91 Coal-Tar Protective Coatings and Linings for Steel Water Pipelines - Enamel and Tape - Hot Applied

C651-92 Disinfecting Water Mains

C701-88 Cold Water Meters-Turbine Type, for Customer Service

F. National Fire Protection Association (NFPA):

54-92 National Fuel Gas Code

G. American Welding Society (AWS):

A5.8-92 Filler Metals for Brazing

H. National Association of Plumbing - Heating - Cooling Contractors (PHCC):

National Standard Plumbing Code - 1996

I. Cast Iron Soil Pipe Institute (CISPI):

301-90 Hubless Cast Iron Soil and Fittings

J. International Association of Plumbing and Mechanical Officials (IAPMO):

Uniform Plumbing Code - 1991

IS6-93 Installation Standard

K. Manufacturers Standardization Society of the Valve and Fittings Industry, Inc. (MSS):

SP-67-95 Butterfly Valve of the Single flange Type (Lug Wafer)

SP-70-90 Cast Iron Gate Valves, Flanged and Threaded Ends.

SP-72-92 General Purpose Ball Valves

SP-80-87 Gate Valve-Bronze

L. American Society of Sanitary Engineers (ASSE):

1001-70 Pipe Applied Atmospheric Type Vacuum Breakers

1013-93 Reduced Pressure Principle Backflow Preventers

1015-93 Double Check Backflow Prevention Assembly

1018-86 Performance for trap seal primer valve-water supply fed

1020-81 Vacuum Breakers, Anti-Siphon, Pressure Type

M. Factory Mutual (FM):

1680-89 Coupling Used in Hubless Cast Iron Systems for Drains, Waste and Vent Systems.

PART 2 - PRODUCTS

2.1 SANITARY, WASTE, STORM WATER DRAIN AND VENT PIPING

A. Cast Iron Soil Pipe and Fittings: Used for pipe buried in or in contact with earth and for extension of pipe to a distance of approximately 1500 mm (5 feet) outside of building walls and interior waste and vent piping above grade. Pipe shall be bell and spigot, modified hub, or plain end (no-hub) as required by selected jointing method.

1. Material, (Pipe and Fittings): ASTM A74, C1SP1-301, Service Class.
2. Joints: Provide any one of the following types to suit pipe furnished.
   a. Lead and oakum and caulked by hand.
   b. Double seal, compression-type molded neoprene gasket. Gaskets shall suit class of pipe being jointed.
   c. Mechanical: Meet the requirements and criteria for pressure, leak, deflection and shear tests as outlined in Factory Mutual No. 1680 for Class 1 couplings.
      1) Stainless steel clamp type coupling of elastomeric sealing sleeve, ASTM C564 and a Series 300 stainless steel shield and clamp assembly. Sealing sleeve with center-stop to prevent contact between pipes/fittings being joined shall be marked ASTM C564.
      2) Cast Iron coupling with neoprene gasket and stainless steel bolts and nuts.
   d. Mechanical Grooved Couplings: Shall consist of ductile iron (ASTM A536, Grade 65-45-12), or malleable iron (ASTM A47, Grade 32510) housings, a pressure responsive elastomeric gasket (ASTM D2000), and steel track head bolts. Shall be for use on pipe and fittings grooved to the manufacturer's specifications. Couplings and fittings to be of the same manufacturer.
   e. Adapters: Where service weight pipe is connected to extra heavy pipe and extra heavy fittings of chair carriers, provide adapters or similar system to make tight, leakproof joints.

B. Steel Pipe and Fittings: May be used for vent piping and storm water piping above grade.
   1. Pipe Galvanized: ASTM A53, standard weight.
   2. Fittings:
      a. Soil, Waste and Drain Piping: Cast iron, ANSI B16.12, threaded, galvanized.
      b. Sanitary and Exhaust Vent Piping: Malleable iron, ANSI B16.3, or cast iron, ANSI B16.4. All piping shall be of the same kind. Couplings of vent piping may be standard couplings furnished with pipe.
      c. Unions: Tucker connection or equivalent type throughout.
      d. Mechanical Grooved Couplings: Shall consist of ductile iron (ASTM A536, Grade 65-45-12), or malleable iron (ASTM A47, Grade 32510)

housings, a pressure responsive elastomeric gasket (ASTM D2000), and steel track head bolts. Shall be for use on pipe and fittings grooved to the manufacturer's specifications. Couplings and fittings to be of the same manufacturer.

C. Copper Tube, (DWV): May be used for piping above ground, except for urinal drains.
   1. Tube: ASTM B306.
   2. Fittings:
      a. Solder type.
      b. Grooved fittings, 50 to 150 mm (2 to 6 inch) wrought copper conforming to ASTM B75 C12200,125 to 150 mm (5 to 6 inch) bronze casting conforming to ASTM B584, CDA 844(81-3-7-9). Mechanical grooved couplings, ductile iron, ASTM A536 (Grade 65-45-12), or malleable iron, ASTM A47 (Grade 32510) housings, with EPDM gasket, steel track head bolts, ASTM A183, coated with copper colored alkyd enamel.
   3. Joints: ASTM B32, 50/50, special alloy, lead free. Solder using non-corrosive flux.

2.2 INTERIOR DOMESTIC WATER PIPING

A. Pipe: Copper tube, ASTM B88, type K or L, drawn. For pipe 150 mm (6 inches) and larger, stainless, steel ASTM A312, schedule 10 may be used.

B. Fittings for Copper Tube:
   1. Wrought copper or bronze castings conforming to ANSI B16.18 and B16.22. Unions shall be bronze, Fed. Spec. WW-U-516. Solder or braze joints.
   2. Grooved fittings, 50 to 150 mm (2 to 6 inch) wrought copper ASTM B75 C12200, 125 to 150 mm (5 to 6 inch) bronze casting ASTM B584, CDA 844. Mechanical grooved couplings, ductile iron, ASTM A536 (Grade 65-45-12), or malleable iron, ASTM A47 (Grade 32510) housing, with EPDM gasket, steel track head bolts, ASTM A183, coated with copper colored alkyd enamel.
   3. Mechanically formed tee connection: Form mechanically extracted collars in a continuous operation by drilling pilot hole and drawing out tube surface to form collar, having a height of not less than three times the thickness of tube wall. Adjustable collaring device shall insure proper tolerance and complete uniformity of the joint. Notch and dimple joining branch tube in a single process to provide

free flow where the branch tube penetrates the fitting. Braze joints.

C. Fittings for Stainless Steel:

1. Stainless steel butt-welded fittings, Type 316, Schedule 10, conforming to ANSI B16.9.
2. Grooved fittings, stainless steel, Type 316, Schedule 10, conforming to ASTM A403. Segmentally fabricated fittings are not allowed. Mechanical grooved couplings, ductile iron, ASTM A536 (Grade 65-45-12), or Malleable iron, ASTM A47 (Grade 32510) housing, with EPDM gasket, steel track head bolts, ASTM A183, coated with copper colored alkyd enamel.

D. Adapters: Provide adapters for joining screwed pipe to copper tubing.

E. Solder: ASTM B32 Composition Sb5 HA or HB. Provide non-corrosive flux.

F. Brazing alloy: AWS A5.8, Classification BCuP.

2.3 EXPOSED WATER, AND WASTE PIPING

A. Finished Room: Use full iron pipe size chrome plated brass piping for exposed water, waste, fuel gas, medical and laboratory gas piping connecting fixtures, casework, cabinets, equipment and reagent racks when not concealed by apron including those furnished by the Government or specified in other sections.

1. Pipe: Fed. Spec. WW-P-351, standard weight.
2. Fittings: ANSI B16.15 cast bronze threaded fittings, (125 and 250).
3. Nipples: ASTM B 687, Chromium-plated.
4. Unions: Fed. Spec. WW-U-516, Brass or Bronze. Unions 65 mm (2-1/2 inches) and larger shall be flange type with approved gaskets.
5. Valves: Fed. Spec. WW-V-35, Brass or bronze.

2.5 VALVES

A. Asbestos packing is prohibited.

B. Shut-off:

1. Cold, Hot and Recirculating Hot Water:
   a. Fifty millimeter (2 inches) and smaller:
      1) Ball, Fed. Spec. WW-V-35, Type II, Class 125, Style 1, three piece or double union end construction, full ported, full flow, with solder end connections, 2750 kPa (400 psi) WOG, MSS-SP-67.
   b. Larger than 50 mm (2 inches): Butterfly, iron body, aluminum bronze disc, 416 stainless steel stem, EPDM seat, wafer design, lever operator to six 150 mm (6 inch)size, gear operated and

crank for 200 mm (8 inches) and above, 1375 kPa (200 pound) WOG, Fed. Spec WW-V-1967.

c. One hundred millimeters (4 inches) and larger:

1) Gate, MSS-SP-70, wedge disc, class 125, cast iron body with bronze trim, flanged.

2) Grooved end butterfly valves with ductile iron body and disc core ASTM A536. Disc rubber coated with compatible material for intended service, maximum working pressure 2050 kPa (300 pounds psi) grooved ends for connection with mechanical grooved couplings.

C. Check:

1. Less than 100 mm (3 inches) and smaller): Bronze body and trim, swing type, MSS-SP-80, 850 kPa (125 pound) WSP.

2. Larger than 100 mm (4 inches and larger):

a. Iron body, bronze trim, swing type, vertical or horizontal installation, flange connections, 1375 kPa (200 pound) WOG.

b. Ductile iron (ASTM A536) or malleable iron (ASTM A47) body, stainless steel or aluminum bronze trim, dual disc, spring loaded, non-slamming design with grooved ends for connection with mechanical grooved couplings. Consult manufacturer for appropriate elastomeric seal for intended service. Maximum working pressure 3450 kPa (500 pounds psi), depending on size.

D. Globe:

1. Eighty millimeters (3 inches) or smaller: Bronze body and bonnet, MSS-SP-80, 850 kPa (125 pound) WSP.

2. Larger than 80 mm (3 inches): Similar to above, except with cast iron body and bronze trim.

2.6 CLEANOUTS

A. Same size as the pipe, up to 100 mm (4 inches); not less than 100 mm (4 inches) for larger pipe. Cleanouts for chemical waste drain pipe shall be of same material as the pipe. Cleanouts shall be easily accessible. Provide a minimum clearance of 600 mm (24 inches) for the rodding.

B. In Floors: Floor cleanouts shall have cast iron body and frame with square adjustable scoriated secured nickel bronze top. Unit shall be vertically adjustable for a minimum of 50 mm (2 inches). When a waterproof membrane is used in the floor system, provide clamping collars on the cleanouts. Cleanouts shall consist of "Y" fittings and 3 mm (1/8 inch) bends with brass or bronze screw plugs. Cleanouts in the

resilient tile floors, quarry tile and ceramic tile floors shall be provided with square top covers recessed for tile insertion. In the carpeted areas, provide carpet cleanout markers. Provide two way cleanouts where indicated on drawings.

C. Provide cleanouts at or near the base of the vertical stacks with the cleanout plug located approximately 600 mm (24 inches) above the floor. If there are no fixtures installed on the lowest floor, the cleanout shall be installed at the base of the stack. Extend the cleanouts to the wall access cover. Cleanout shall consist of sanitary tees. Furnish nickel-bronze square frame and stainless steel cover with minimum opening of 150 by 150 mm (6 by 6 inches) at each wall cleanout. Where the piping is concealed, a fixture trap or a fixture with integral trap, readily removable without disturbing concealed roughing work, shall be accepted as a cleanout equivalent providing the opening to be used as a cleanout opening is the size required by the NPHCC National Standard Plumbing Code.

D. In horizontal runs above grade, cleanouts shall consist of cast brass tapered screw plug in fitting or caulked/no hub cast iron ferrule. Plain end (no-hub) piping in interstitial space or above ceiling may use plain end (no-hub) blind plug and clamp.

2.7 TRAPS

Provide on all sanitary branch waste connections from fixtures or equipment not provided with traps. Exposed brass shall be polished brass chromium plated with nipple and set screw escutcheons. Concealed traps may be rough cast brass or same material as pipe connected to. Slip joints not permitted on sewer side of trap. Traps shall correspond to fittings on cast iron soil pipe or steel pipe respectively, and size shall be as required by connected service or fixture.

2.8 STRAINERS

A. Provide on equipment subject to sediment damage and where shown on drawings. Strainer element shall be removable without disconnection of piping.

B. Water: Basket or "Y" type with easily removable cover and brass strainer basket.

C. Body: Smaller than 80 mm (3 inches), brass or bronze; 80 mm (3 inches) and larger, cast iron or semi-steel.

2.9 PRESSURE GAUGES FOR WATER AND SEWAGE USAGE

ANSI B40.1 all metal case 114 mm (4-1/2 inches) diameter, bottom connected. throughout, graduated as required for service, and identity labeled. Range shall be 1375 kPa (0 to psi) gauge.

2.10 DIELECTRIC FITTINGS

Provide dielectric couplings or unions between ferrous and non-ferrous pipe.

2.11 STERILIZATION CHEMICALS

A. Liquid Chlorine: Fed. Spec. BB-C-120.

B. Hypochlorite: Fed. Spec. 0-C-114, or Fed. Spec. O-S-602, grade B.

2.12 WATER HAMMER ARRESTER:

A. Closed copper tube chamber with permanently sealed 410 kPa (60 psig) air charge above a triple o-ring piston. Three high heat Buna-N 0-rings pressure packed and lubricated with FDA approved Dow Corning No. 11 silicone compound. All units shall be designed in accordance with ASSE 1010 for sealed wall installations without an access panel. Size and install in accordance with Plumbing and Drainage Institute requirements. Unit shall be as manufactured by Precision Plumbing Products Inc., Watts or Sioux Chief. Provide water hammer arrestors at all solenoid valves, at all groups of two or more flush valves, at all quick opening or closing valves, and at all medical washing equipment.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General: Comply with the PHCC National Standard Plumbing Code and the following:

1. Install branch piping for water, waste and fuel gas, from the respective piping systems and connect to all fixtures, valves, cocks, outlets, casework, cabinets and equipment, including those furnished by the Government or specified in other sections.
2. Pipe shall be round and straight. Cutting shall be done with proper tools. Pipe, except for plastic and glass, shall be reamed to full size after cutting.
3. All pipe runs shall be laid out to avoid interference with other work.
4. Install valves with stem in horizontal position whenever possible. All valves shall be easily accessible. Install valve in each water connection to fixture.

5. Install union and shut-off valve on pressure piping at connections to equipment.
6. All gravity waste drain lines inside the building with vertical drops over 6 m (20 feet) shall be provided with joint restraint on the vertical drop and horizontal offset or branch below the vertical drop. Joint restraint shall be accomplished by threaded, soldered, lead and oakum or grooved joints or a combination of pipe clamps and tie-rods as detailed in NFPA 24. Vertical joint restraint shall be provided from the fitting at the bottom of the vertical drop through every joint up to the riser clamp at the floor penetration of the floor above. Horizontal joint restraint shall be provided from the same fitting at the bottom of the vertical drop through every joint on the horizontal offset or branch for a minimum of 18 m (60 feet) or to anchoring point from the building structure. Joint restraint below ground shall be accomplished by thrust blocks detailed in NFPA 24.
7. All piping shall be supported per of the National Standard Plumbing Code, Chapter No. 8. If the vertical distance exceeds 6 m (20 feet) for cast iron pipe additional support shall be provided in the center of that span. Provide all necessary auxiliary steel to provide that support.
8. Install cast escutcheon with set screw at each wall, floor and ceiling penetration in exposed finished locations and within cabinets and millwork.
9. Penetrations:
    a. Fire Stopping: Where pipes pass through fire partitions, fire walls, smoke partitions, or floors, install a fire stop that provides an effective barrier against the spread of fire, smoke and gases as specified in Section 07270, FIRESTOPPING. Completely fill and seal clearances between raceways and openings with the fire stopping materials.
    b. Waterproofing: At floor penetrations, completely seal clearances around the pipe and make watertight with sealant as specified in Section 07920, SEALANTS AND CAULKING.

B. Piping shall conform to the following:

1. Waste, Storm Water Drain and Vent Drain to main stacks:

	Pipe Size	Minimum Pitch

a.	80 mm (3 inches) and smaller	1 : 50 (1/4" to the foot).
b.	80 mm (4 inches) and larger	1 : 100 (1/8" to the foot).

2. Exhaust Vent: Extend separately through roof. Sanitary vents shall not connect to exhaust vents.
3. Domestic Water:
   a. Where possible, grade all lines to facilitate drainage. Provide drain valves at bottom of risers. All unnecessary traps in circulating lines shall be avoided.
   b. Connect branch lines at bottom of main serving fixtures below and pitch down so that main may be drained through fixture. Connect branch lines to top of main serving only fixtures located on floor above.

3.2 TESTS

A. General: Test system either in its entirety or in sections.

B. Soil, Waste, Storm Water Drain, Vent, and Silver Recovery Systems: Conduct before trenches are backfilled or fixtures are connected.
   1. Water Test: If entire system is tested, tightly close all openings in pipes except highest opening, and fill system with water to point of overflow. If system is tested in sections, tightly plug each opening except highest opening of section under test, fill each section with water and test with at least a 3 m (10 foot) head of water. In testing successive sections, test at least upper 3 m (10 feet) of next preceding section so that each joint or pipe except upper most 3 m (10 feet) of system has been submitted to a test of at least a 3 m (10 foot) head of water. Keep water in system, or in portion under test, for at least 15 minutes before inspection starts. System shall then be tight at all joints.
   2. Air Test: Maintain air pressure of 35 kPa (5 psi) gage for at least 15 minutes without leakage. Use force pump and mercury column gage.
   3. Final Tests: Either one of the following tests may be used.
      a. Smoke Test: After fixtures are permanently connected and traps are filled with water, fill entire drainage and vent systems with smoke under pressure of 1.3 kPa (one inch of water) with a smoke machine. Chemical smoke is prohibited.

b. Peppermint Test: Introduce (two ounces) of peppermint into each line or stack.

C. Potable Water System: Test after installation of piping and domestic water heaters, but before piping is concealed, before covering is applied, and before plumbing fixtures are connected. Fill systems with water and maintain hydrostatic pressure of 690 kPa (100 psi) gage for two hours. No decrease in pressure is allowed. Provide a pressure gage with a shutoff and bleeder valve at the highest point of the piping being tested.

D. All Other Piping Tests: Test new installed piping under 1 1/2 times actual operating conditions and prove tight.

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